

REMARKS

Claims 1-40 were previously pending in the application. In the Office action mailed November 29, 2002, claims 1-40 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,140,228 (Shan et al.) in view of U.S. Patent No. 6,204,175 (Lai et al.). Applicant thanks the Examiner for attention to the application. Applicant's representative also thanks the Examiner for a brief telephone call in which the Examiner discussed reactive gases found in Lai et al.

Claims 1, 21, and 41 are now amended, and claims 8 and 27 are cancelled.

Claim 1, as amended, includes "depositing a seed layer of aluminum on the metal liner layer, with the temperature of the semiconductor device below 300 degrees centigrade; exposing the seed layer of aluminum to a reactive gas; and depositing aluminum on the seed layer, with the temperature of the semiconductor device greater than 350 degrees centigrade...". The Office action states that Shan et al. teaches in columns 5-8 a process that comprises depositing a metal liner layer 3, depositing a seed layer of aluminum 4 on the metal liner layer 3, and depositing aluminum on the seed layer to fill the aperture. The Office action further states that Shan et al. teaches the seed layer deposited at a temperature within the range of 40-300°C... the aluminum layer is deposited in a wafer temperature in the range of 300 to 420°C.

The Office action then states that Shan et al. teaches all the limitations in the claims with the exception of exposing the seed layer to a reactive gas comprising oxygen or oxygen with argon.

The Office action states that Lai et al. teaches the process of filling trenches in vias with aluminum and includes the steps of depositing a metal liner layer with a semiconductor device, depositing a seed layer for aluminum on the metal liner layer, and exposing the seed layer to a reactive gas...

The Office action concludes that it would have been obvious to one of ordinary skill in the art to expose the seed layer to a reactive gas such as the one contained in the deposition taught by Lai et al. for the disclosed intended purpose.

Turning first to Lai et al., Lai et al. has "determined that it is desirable to pretreat the surface of the refractory metal nitride layer with the metalorganic precursor prior to the chemical vapor deposition of aluminum." Lai et al., col. 4, lines 27-31. The "metalorganic precursor monolayer serves as a uniform 'seed' layer for the later aluminum film, with this seed layer acting as nucleation sites for the aluminum." Lai et al., col. 4, lines 55-57. Accordingly, the seed layer of Lai et al. is not an aluminum seed layer, as specified by claim 1.

In addition, it is not clear from Lai et al. that the seed layer, as discussed in Lai et al., is exposed to a reactive gas. See Lai et al., col. 3, lines 35-40 ("As is conventional, the chemical vapor deposition process may be carried out at pressures of from atmospheric down to 10^{-3} torr, and preferably from about 1.0 to 0.1 torr. A vacuum may be created in chamber 10 using turbo pump 12 and backing pump 14.")

Further, claim 1 specifies "depositing a seed layer of aluminum...with the temperature of the semiconductor device below 3000 centigrade...and depositing aluminum on the seed layer, with the temperature of the semiconductor device greater than 3500 centigrade...".

In Lai et al., "a constant nominal temperature is established with the substrate, preferably at a temperature of between about 00 to 600°C, and most preferably from about 500 to 300°C". Lai et al., col. 3, lines 42-45. In Lai et al., [i]n a preferred embodiment of the invention the substrate is maintained at substantially the same temperature throughout the process." Lai et al., col. 5, lines 43-46.

Accordingly, it appears that Lai et al. teaches a process in which a metalorganic precursor is laid down as a seed layer and the

substrate is maintained at a substantially constant temperature. Even if Lai et al. and Shan et al. could be combined, it does not appear that such would result in a method including depositing a metal liner layer on a semiconductor device including an aperture; depositing a seed layer of aluminum on the metal liner layer with the temperature of the semiconductor device below 300 degrees centigrade; exposing the seed layer of aluminum to a reactive gas; and depositing aluminum on the seed layer, with the temperature of the semiconductor device greater than 350 degrees centigrade, to fill the aperture, whereby the aperture is substantially filled, creating a via.

Accordingly, claim 1 and dependent claims 2-7 and 9-20 are allowable in view of Shan et al. and Lai et al.

Claim 21, as amended, specifies "applying a seed layer of aluminum onto the metal liner layer with the temperature of the semiconductor device being below 300 degrees centigrade; treating the seed layer of aluminum with reactive gases; and depositing a layer of aluminum onto the seed layer with the temperature of the semiconductor device being greater than 350 degrees centigrade".

As previously discussed, the seed layer of Lai et al. is of a metalorganic precursor. In addition, in the process of Lai et al., the temperature of the semiconductor device remains relatively constant. Moreover, claim 21 specifies "treating the seed layer of aluminum...". A review of Lai et al. and Shan et al. indicates that neither discusses treating the seed layer of aluminum with reactive gas.

Accordingly claim 21, and dependent claims 22-26, and 28-39 are allowable in view of Lai et al. and Shan et al.

Claim 40, as amended, specifies "depositing a seed layer of cold aluminum on a metal liner layer, exposing the seed layer to a reactive gas containing atmosphere, and depositing hot aluminum on the seed layer." As discussed above, a combination of Shan et al. and Lai et al. does not provide such, and claim 40 is allowable in view of Shan et al. and Lai et al.

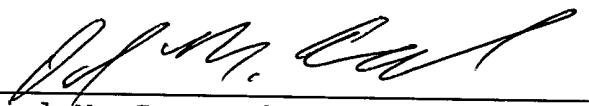
Application No. 09/992,743

As the application is now in condition for allowance, allowance of the same respectfully requested. If the claims are not found allowable, applicant's undersigned representative respectfully requests that a call be made to him.

Respectfully submitted,

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